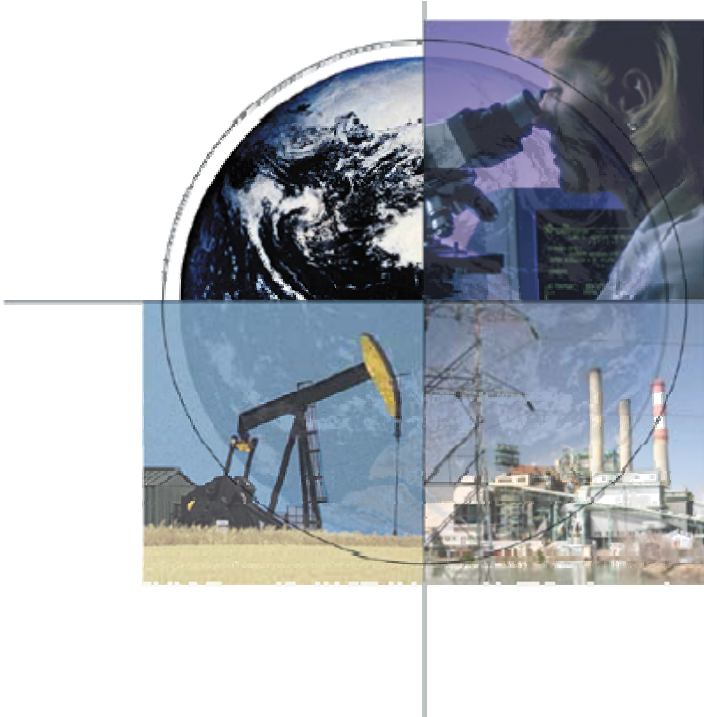


Western Greenbrier Co-production Demonstration Project

Benefits Presentation



Clean Coal Power Initiative - Round 1 -

Demonstration of an 98 MWe
Alstom Compact Inverted Cyclone,
Circulating Fluidized-Bed
Combustor in a Co-production
Facility

Nelson Rekos – Major Projects Division
National Energy Technology Laboratory



Outline

- **Executive Summary**
- **Project Information**
 - Plant, fuel, location, cost, and schedule
 - Team members
 - Circulating Fluidized-Bed (CFB) Process
 - Combustion Utilization By-products (CUB)
 - Unique contribution
 - Anjean Dump Site: Existing Site Conditions



Outline (continued)

- **Estimated Benefits**
 - Approach
 - Market penetration assumptions
 - Pollutant reductions
 - Total emissions
 - Regional
 - Anjean annotated topographic map
 - National
- **Conclusions**



Executive Summary

- **Demonstration projects are critical to successful commercialization of technology developed under U.S. Department of Energy Fossil Energy R&D program**
- **Facility will employ CFB combustor technology burning waste coal**
 - Environmental safeguards will place it among the cleanest and most cost-effective coal-burning electric generation facilities
- **Western Greenbrier Co-production Demonstration Project success will set an example for remediation and recovery of many legacy waste coal dumps produced from historic coal mining and preparation operations**



Executive Summary (continued)

- **Project carries potential for enormous environmental and economic benefits throughout coal mining areas with existing waste coal dumps**
- **West Virginia Department of Environmental Protection (DEP)**
 - Estimates 300 to 400 million tons of waste coal in dumps across southern part of state
 - Identified waste coal dumps as state's number one environmental hazard
- **Dumps impose ongoing costs in containment, neutralization of acid runoff, and assurance of integrity of containment structures**
 - Estimates to eliminate dumps run as high as \$2 to \$3 billion



Executive Summary (continued)

- Along with its 98 MWe plant, Western Greenbrier will produce CUB for potential use as building materials and for use in acid mine waste neutralization
- In addition to its technological and environmental benefits, this project will provide an income stream to three small communities that will own it, as well as provide lasting, quality jobs
- An “Eco-Park” is visualized using steam and hot water supplied by co-production facility
 - Products could include vegetables and tilapia, a fast-growing food fish suitable to “fish farm” operations



Project Information

Plant, Fuel, Location, Cost, and Schedule

- A new 98 MWe Alstom CFB combustor fires waste coal recovered from abandoned coal dumps
- Waste coal is recovered and cleaned to reduce the ash content and increase the Btu value before delivery to power plant
- Location: Rainelle, Greenbrier County, WV
- Project cost: \$215 million; DOE share: \$107.5 million
- Schedule:
 - 2004 Project start
 - 2007 to 2009 Construction
 - 2010 Completion



Project Information (continued)

Team Members

- **Western Greenbrier Co-generation, LLC**
 - Project, sited in Rainelle, will be structured as a municipal entity owned by neighboring WV towns of Rainelle, Quinwood and Rupert
- **Alstom Power (Windsor, CT)**
 - Will provide power island
- **Hazen Research (Golden, CO)**
 - Will develop ash by-product processes and facilities design



Project Information (continued)

Circulating Fluidized-Bed (CFB) Process

- **CFB systems differ from other combustors in that fuel particles are fed into lower portion of combustor, along with a solid sorbent (limestone), where initial combustion occurs**
- **As fuel particles decrease in size due to combustion, they are carried higher in the furnace**
- **As particles shrink, fuel and some sorbent is collected in a cyclone separator**
- **This material is recycled to lower portion of combustor**



Project Information (continued)

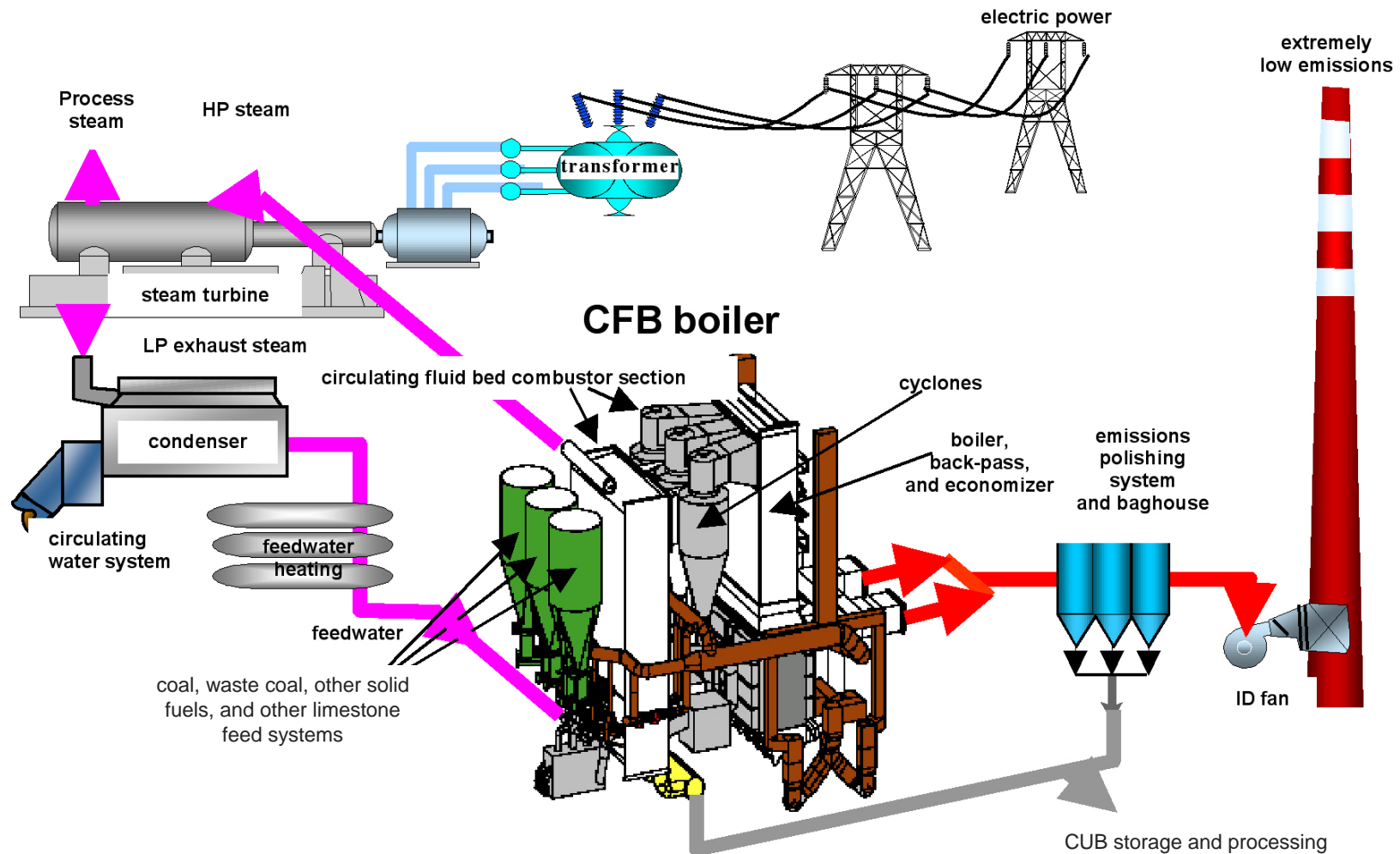
Circulating Fluidized-Bed (CFB) Process

- **With continuous fresh coal and limestone feed, ash material is drawn off at bottom of combustor to control the amount of solids in the loop**
- **Steam is generated in tubes placed along walls of combustor keeping temperatures between 1,500° and 1,700°F through a large heat exchange surface, thus limiting NO_x formation**
- **Primary purpose of limestone is to absorb sulfur from coal as it is released from combustion, thereby reducing oxides of sulfur (SO_x) present in flue gas**
- **Any NO_x and SO_x remaining after cyclone are further reduced by selective non-catalytic reduction (SNCR) and wet lime scrubbing, respectively**



Project Information (continued)

Circulating Fluidized-Bed (CFB) Process Schematic



Project Information (continued)

Combustion Utilization By-products (CUB)

- **CUB (ash) from Western Greenbrier can be marketed**
 - Project generates a class “C” ash, having adequate calcium and is quite pozzolanic, and is useful for construction materials
 - Local coals typically form a class “F” ash, having a low calcium content and must be bolstered with calcium via limestone
- **Limestone from the Lewisburg, WV area is available for**
 - Bolstering type “F” ash
 - Sulfur capture in the CFB



Project Information (continued)

Unique Contribution

- **This CFB combustor features a unique “inverted” cyclone separator and a mid-support structure with these benefits:**
 - 40% smaller boiler footprint with a lower overall building height, decreasing overall structural steel tonnage by 60%
 - Less direct construction labor
 - Self-supporting assembly process for enhanced construction safety and reduced costs
 - Overall construction time cut by 6-8 weeks
- **Possible “Eco-Park” to use steam and hot water from project**

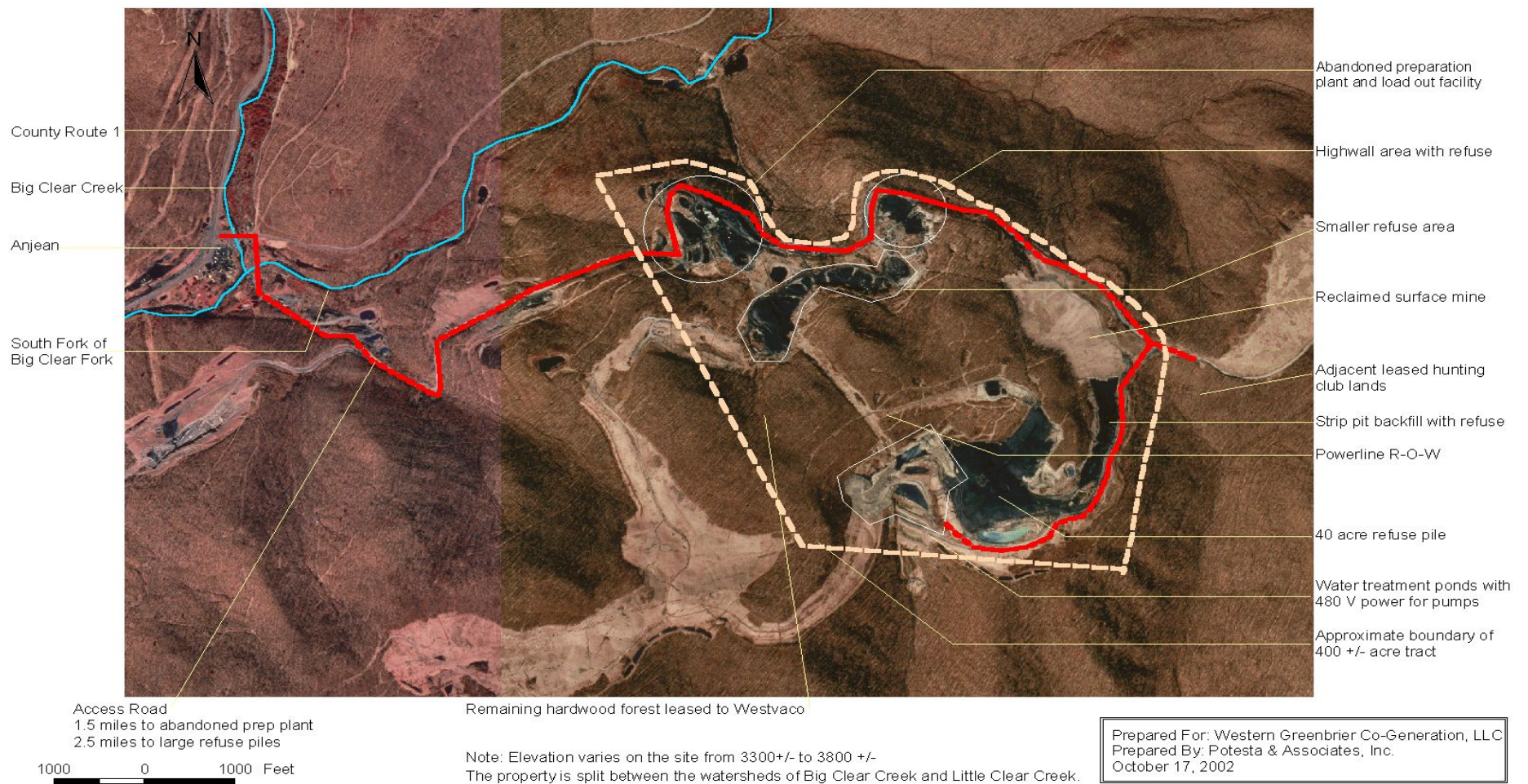


View of overall site, looking southeast



Project Information (continued)

Anjean Dump Site: Existing Site Conditions



Estimated Benefits

Approach

- Forecast market penetration
- Quantify differences between conventional power plants with and without CFB technology being demonstrated



Estimated Benefits (continued)

Market Penetration Assumptions

- **West Virginia DEP estimates 300 to 400 million tons of waste coal in existing dumps across southern West Virginia**
- **Potential market throughout all coal mining areas in United States**
 - Assume source of limestone is available, if needed, to promote type “C” pozzolanic ash formation
 - Assume regional market for type “C” pozzolanic ash product



Estimated Benefits (continued)

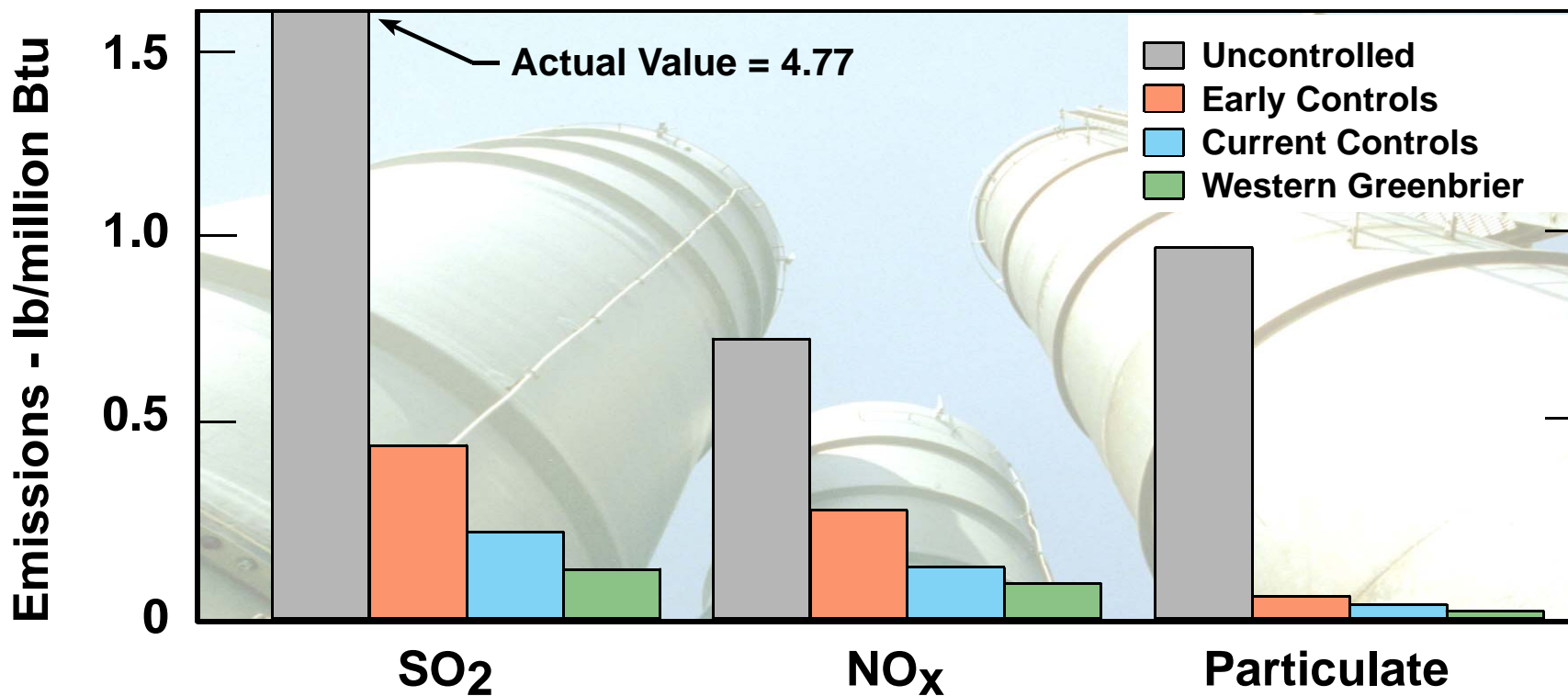
Pollutant Reductions

- Mitigating waste coal dumps reduces acid runoff and facilitates land reclamation
- Treated CFB ash is useful
 - As a construction material
 - As a cement additive
 - To apply to waste coal dumps to neutralize acid runoff



Estimated Benefits (continued)

Total Emissions



Estimated Benefits (continued)

Regional

- **West Virginia DEP spends \$250,000 each year monitoring and treating runoff from Anjean dump**
- **Mitigating Anjean's approximately 4 million tons of waste coal and coal fines dump (largest in West Virginia) would be environmentally beneficial and cost-effective**



Waste Coal Dump



Estimated Benefits (continued)

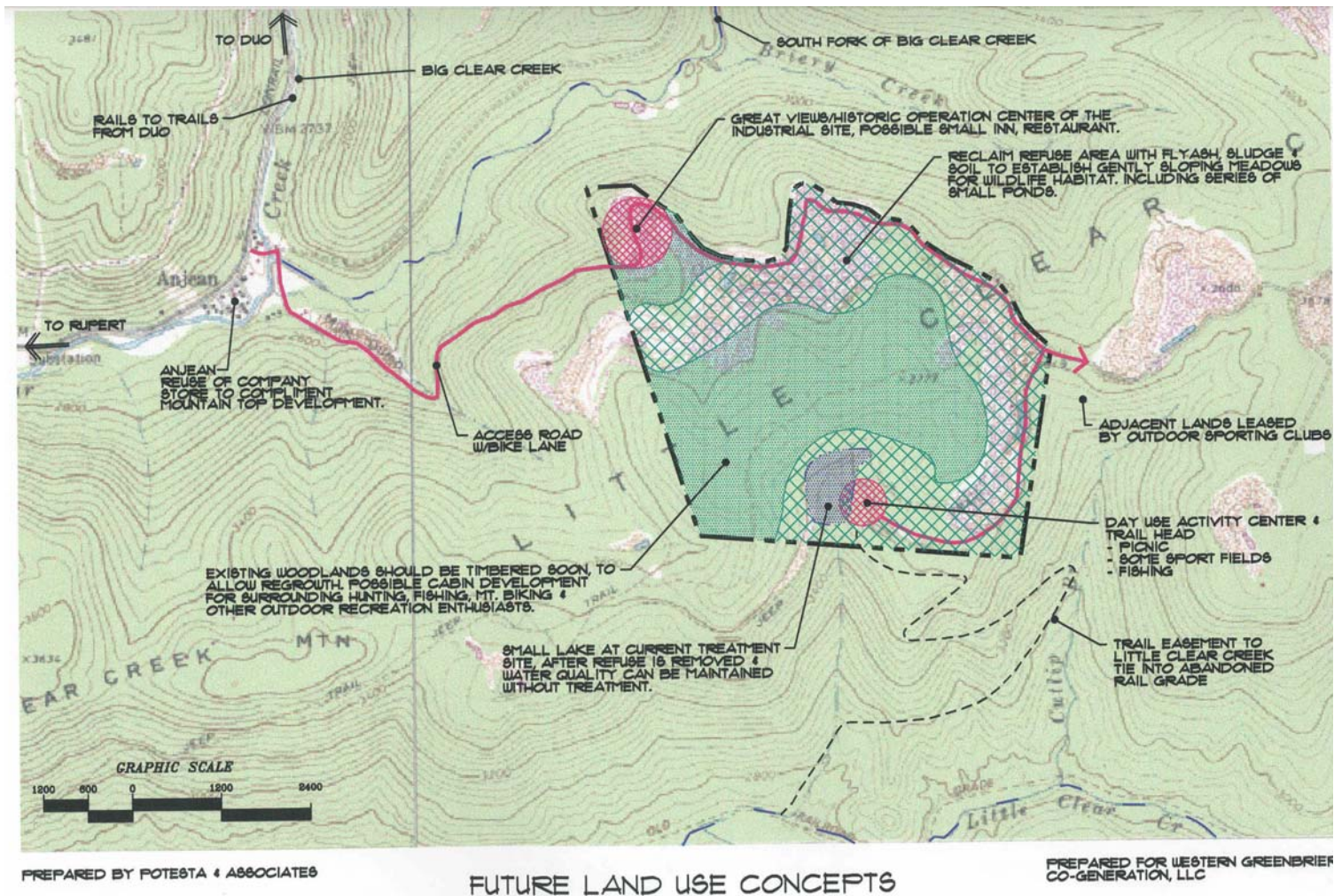
Regional

- **Project will bring high-quality jobs to economically challenged area of southern West Virginia**
 - Construction will bring an influx of skilled labor as well as employment for local labor
 - Plant operations will create permanent jobs for local residents
 - Envisioned “Eco-Park” will contribute jobs to local economy
- **Waste coal dumps like Anjean will be recovered for beneficial use**
 - Area residents want to reclaim Anjean waste coal dump for use as a community park and recreation area (see annotated map)




Project Information (continued)

Anjean Annotated Topographic Map



Estimated Benefits (continued)

National

- 
- **Project constitutes a model for private industry, local, state, or federal organizations to eliminate liabilities from legacy coal mining and preparation operations in a manner that profits rather than costs taxpayers**
 - West Virginia could save \$2 to \$3 billion
 - Other coal producing states will benefit from applying this technology to waste coal dumps



Conclusions

- **Land reuse and CUB benefits of Western Greenbrier Co-production Demonstration Project will:**
 - Encourage building electric power plants at former mining facilities needing reclamation
 - Enable unusable land to be reclaimed for commercial use throughout the nation
 - Mitigate abandoned mine spoils and associated environmental problems
 - Provide economic benefits for local communities in mine spoil areas



Reclaimed Land



**Visit the NETL web site for information on all
Power Plant Improvement Initiatives and
Clean Coal Power Initiative projects**

www.netl.doe.gov/technologies/coalpower/cctc

